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ABSTRACT

The summary information contained in this report provides teachers, school administrators, students, and the general public with an overview of the results from the June 1998 administration of the Science 30 Diploma Examination by the Alberta Department of Education in Canada. This information is most helpful when used with the detailed school and jurisdiction reports that are provided to schools and school jurisdiction offices. Findings indicate that 91.5% of the 811 students who took the test achieved the acceptable standard, and 7.5% of those students achieved the standard of excellence. Topics discussed include a description of the examination, achievement of standards, results and examiners' comments, multiple-choice and numerical-response questions, and written-response questions. (ASK)

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Science 30

Diploma Examination Results
Examiners' Report for June 1998

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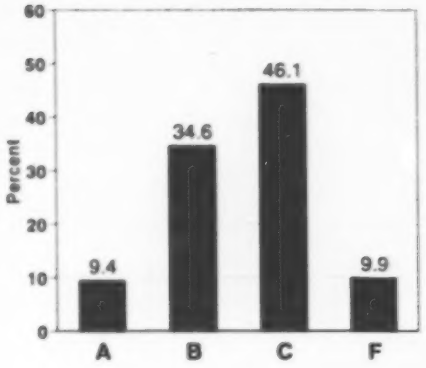
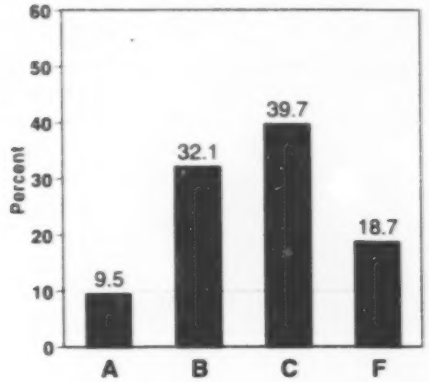
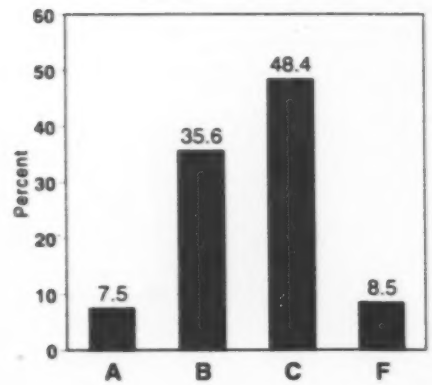
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, and students with an overview of results from the June 1998 administration of the Science 30 Diploma Examination. This information is most helpful when used in conjunction with the detailed school and jurisdiction reports that are electronically provided to schools and school jurisdiction offices. A provincial report containing a detailed analysis of the combined January, June, and August results is made available annually.

Description of the Examination

The Science 30 Diploma Examination consists of 44 multiple-choice questions worth 55%, 12 numerical-response questions worth 15%, and 2 written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 811 students in Alberta who wrote the June 1998 examination.

- 91.5% of the 811 students achieved the acceptable standard (a final course mark of 50% or higher).
- 7.5% of students achieved the standard of excellence (a final course mark of 80% or higher).

Students demonstrated a good understanding of the sources of pollution and its effects.

Students continue to experience difficulty balancing nuclear reactions and calculating the energy produced by nuclear reactions. Although they were successful with some multistep problems, the manipulation of more complex formulas remains a challenge.

Science 30 students continued to improve their communication skills. Their answers were generally well organized, and all parts of the written-response questions were addressed. Responses could have been improved by greater use of specific examples to support ideas.

Approximately 46.6% of students who wrote the examination were female. Of these, about 90.2% achieved the acceptable standard in the course, compared with 92.6% of the male students. Approximately 10.1% of the female students achieved the standard of excellence, compared with 5.3% of the male students. The average course mark achieved by the female students was 62.9%, and the male students achieved an average mark of 62.5%.

Provincial Averages

- The average school-awarded mark was 63.0%.
- The average diploma examination mark was 61.7%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 62.7%.

Results and Examiners' Comments

This examination has a balance of question types and difficulties. It is designed so that students achieving the acceptable standard will obtain a mark of 50% or higher, and students achieving the standard of excellence will obtain a mark of 80% or higher.

In the following table, diploma examination questions are classified by question type: multiple choice (MC), numerical response (NR), and written response (WR). The column labelled "Key" indicates the correct response for multiple-choice and numerical-response questions. For numerical-response questions, a limited range of answers was accepted as being equivalent to the correct answer. For multiple-choice and numerical-response questions, the "Difficulty" indicates the proportion (out of 1) of students answering the question correctly. For written-response questions, the "Difficulty" is the mean score (out of 1) achieved by students who wrote the examination.

Questions are also classified by general learner expectations. Even though some questions address more than one GLE, only one GLE was selected for the purpose of this report.

Knowledge:

- GLE 1 Nervous, Circulatory, & Immune Systems
- GLE 2 Genetics
- GLE 3 Chemistry & the Environment
- GLE 4 Gravitational, Electrical, & Magnetic Fields
- GLE 5 Astronomy & the Electromagnetic Spectrum
- GLE 6 The Production & Use of Energy

Skills:

- SPC Scientific Process Skills and Communication Skills

Science, Technology, Society:

- STS Connections Among Science, Technology, & Society

Blueprint

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPC	STS
MC1	C	0.735			✔				✔	✔
MC2	D	0.968					✔			✔
MC3	C	0.375		✔						
MC4	D	0.509	✔							
MC5	B	0.631					✔			
MC6	A	0.576						✔		✔
MC7	D	0.370						✔	✔	✔
NR1	1147	0.760						✔	✔	✔
MC8	A	0.665	✔						✔	
MC9	D	0.843	✔							
MC10	D	0.430	✔							
MC11	C	0.843	✔							
NR2	2314	0.578	✔						✔	✔
MC12	D	0.207	✔						✔	✔
MC13	D	0.769					✔			
MC14	B	0.815	✔							
MC15	B	0.596	✔							
MC16	C	0.464	✔							
MC17	A	0.551	✔							✔
MC18	B	0.655	✔							
MC19	C	0.375	✔							
MC20	A	0.493	✔							
MC21	B	0.845					✔			
MC22	B	0.856		✔					✔	✔

Question	Key	Difficulty	GLE 1	GLE 2	GLE 3	GLE 4	GLE 5	GLE 6	SPC	STS
MC23	D	0.825			✔				✔	
MC24	D	0.625		✔					✔	
NR3	213	0.363		✔					✔	
MC25	C	0.460		✔						✔
MC26	D	0.847				✔				✔
NR4	312	0.777				✔				✔
NR5	8.17	0.396				✔			✔	
MC27	C	0.430					✔			✔
MC28	A	0.658					✔			✔
NR6	3214	0.621					✔			
MC29	A	0.687					✔			
NR7	2.72	0.830					✔		✔	✔
MC30	C	0.891			✔					
MC31	D	0.779			✔					✔
MC32	D	0.543						✔	✔	✔
MC33	C	0.668						✔	✔	✔
MC34	C	0.666			✔				✔	✔
MC35	A	0.567			✔				✔	✔
NR8	2413	0.729			✔				✔	
MC36	B	0.539			✔				✔	
MC37	C	0.752			✔				✔	✔
MC38	B	0.783			✔					✔
MC39	B	0.351						✔	✔	
MC40	C	0.731						✔		✔
NR9	1.7	0.208						✔	✔	
MC41	C	0.554						✔		
MC42	C	0.485						✔		
NR10	11	0.920				✔			✔	
MC43	C	0.740				✔			✔	
NR11	640	0.689				✔			✔	
MC44	A	0.535				✔			✔	
NR12	1700	0.732				✔			✔	
WR1	—	0.617							✔	
WR2	—	0.525								✔

Subtests: Machine Scored and Written Response (Average by Subtest)

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Machine scored: 35.29 out of 56
Multiple choice: 27.69 out of 44
Numerical response: 7.60 out of 12

Written Response: 13.93 out of 24
Question 1: 7.41 out of 12
Question 2: 6.31 out of 12

Raw Score Averages by General Learner Expectation

GLE 1	Nervous, Circulatory, & Immune Systems	8.0	out of	14
GLE 2	Genetics	2.7	out of	5
GLE 3	Chemistry & the Environment	7.3	out of	10
GLE 4	Gravitational, Electrical, & Magnetic Fields	5.6	out of	8
GLE 5	Astronomy & the Electromagnetic Spectrum	6.4	out of	9
GLE 6	The Production & Use of Energy	5.2	out of	10
Skills	Scientific Process Skills & Communication Skills	23.5	out of	38
STS	Connections Among Science, Technology, & Society	21.6	out of	35

Multiple-Choice and Numerical-Response Questions

The following table gives results for eight questions selected from the examination. The table shows the percentage of students in four groups that answered the question correctly. The comments following the table relate to some of the understandings and skills the students may have used to answer these questions.

Percentage of Students Correctly Answering Selected Machine-Scored Questions

	Question Number							
Student Group	**MC3**	**NR3**	**MC25**	**MC6**	**MC30**	**MC31**	**MC32**	**MC33**
All Students	37.5	36.3	46.0	57.6	89.1	77.9	54.3	66.8
Students achieving the *standard of excellence* (80% or higher, or A) on the whole examination	50.6	61.0	77.9	79.2	100	96.1	80.5	93.5
Students achieving the *acceptable standard* (between 50% and 79%, B or C) on the whole examination	38.7	34.4	47.1	60.5	91.9	79.0	54.5	68.7
Students who have not achieved the *acceptable standard* (49% or less, or F) on the whole examination	26.3	30.9	25.7	35.5	73.0	64.5	40.1	46.1

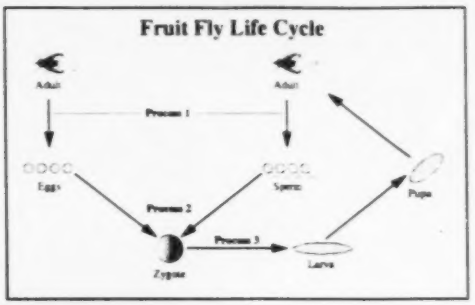
Multiple-choice questions 3 and 25 and numerical-response question 3 provide an indication of students' knowledge and understanding of what happens to the chromosomes during cell processes. Although the students demonstrated a strong understanding of the other biological topics on this examination, they were weaker in this area.

3. The DNA in an athlete's skin cells may mutate after prolonged exposure to the sun. The process that will pass the mutation along to daughter cells is

- **A.** mitosis, and the mutation will be inherited by children of the athlete
- **B.** meiosis, and the mutation will be inherited by children of the athlete
- ***C.** mitosis, and the mutation will not be inherited by children of the athlete
- **D.** meiosis, and the mutation will not be inherited by children of the athlete

On **question 3**, 37.5% of the students responded correctly. By choosing A or B, 46.9% of the students demonstrated that they did not understand that a mutation in a skin cell will not be passed on to the next generation.

Use the following information to answer the next two questions.



Numerical Response

3. Match each process indicated in the diagram with its name.

Fertilization _____ (Record your answer in the **first** column on the answer sheet.)

Meiosis _____ (Record your answer in the **second** column on the answer sheet.)

Mitosis _____ (Record your answer in the **third** column on the answer sheet.)

Answer: 213

In **numerical-response question 3**, only 36.3% of students responded correctly, indicating that many have a limited understanding of the general cell processes involved in a life cycle.

25. The number of chromosomes is 2n (diploid) in the

A. egg and adult
B. sperm and larva
***C.** adult and zygote
D. sperm and zygote

To answer **question 25**, students had to recognize that adult organisms are made up of 2n (diploid) cells. Of the students writing, 46.0% answered correctly. The 73.6% of students who chose C or D may have known that the sperm and egg fuse to produce a 2n zygote.

Multiple-choice questions 6, 30, 31, 32, and 33 provide an indication of students' knowledge and understanding of environmental issues.

6. The combustion of hydrogen fuel in a race official's vehicle used in the cycling event and the oxidation of glucose in the participants' bodies are similar in that both processes

***A.** require oxygen
B. produce carbon dioxide
C. reduce the greenhouse effect
D. contribute to ozone depletion

Question 6 required students to understand that oxygen is needed for burning fuel and for the oxidation of glucose in cells. By choosing B, 38.7% of the students recognized that burning fuel usually produces carbon dioxide. The stronger students realized that burning hydrogen does not produce carbon dioxide. Of the students writing, 57.6% answered this question correctly.

30. The ozone layer in the upper stratosphere is beneficial to living organisms because it absorb

A. radio waves
B. visible radiation
***C.** ultraviolet radiation
D. microwave radiation

Of the students writing, 89.1% answered **question 30** correctly, demonstrating that most students know that ozone absorbs ultraviolet radiation.

Use the following information to answer the next questions.

Net Reaction for the Production of Ground-Level Ozone

$$CO_{(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + O_{3(g)}$$

31. The main sources of the pollutant responsible for this reaction are

A. wind farms
B. nuclear reactors
C. hydroelectric dams
***D.** internal combustion engines

By answering **question 31** correctly, 77.9% of the students recognized that the production of $CO_{2(g)}$ and $O_{3(g)}$ comes from reactions in combustion engines. By choosing B, 13.7% of the students indicated that they thought the reaction occurred in nuclear reactors.

Use the following information to answer the next two questions.

Equations Involving an Energy Change

I $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

II $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n$

III $CF_2Cl_{2(g)} \rightarrow CF_2Cl_{2(l)}$

IV $C_8H_{18(l)} + \frac{25}{2} O_{2(g)} \rightarrow 8CO_{2(g)} + 9H_2O_{(g)}$

32. The equation that represents the change that occurs in internal combustion engines is equation

A. I
B. II
C. III
***D.** IV

On **question 32**, 54.3% of the students responded correctly. Many of the weaker students chose A, which indicates that although they recognized a combustion reaction, they did not recognize that $C_8H_{18(l)}$ (rather than $C_{(s)}$) is the fuel.

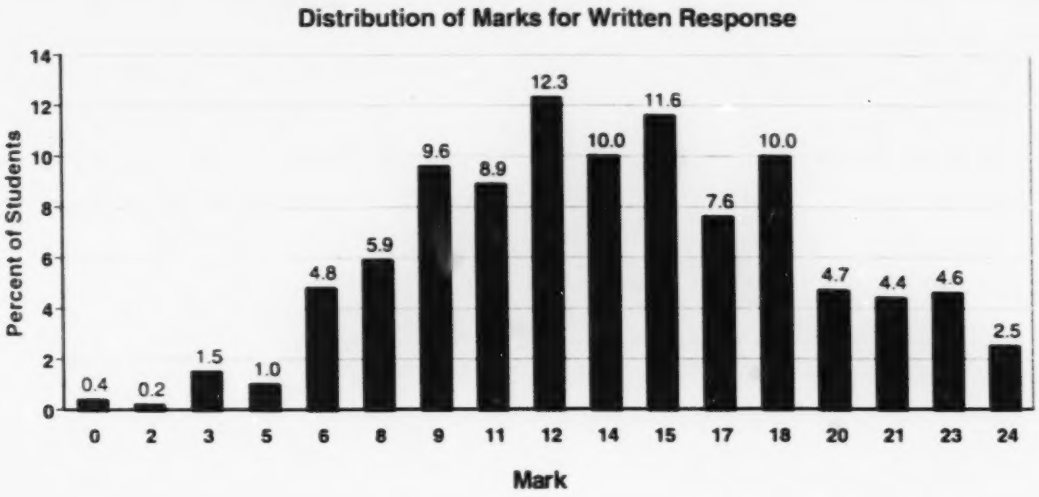
33. The equation that represents the change that occurs in some air-conditioning systems is equation

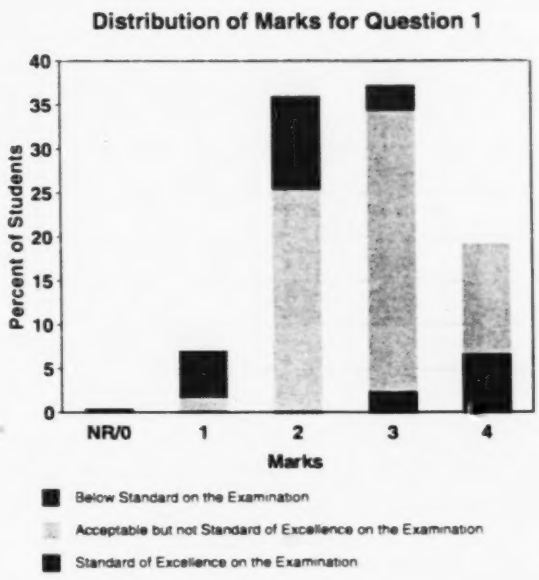
A. I
B. II
***C.** III
D. IV

On **question 33**, 66.8% of the students responded correctly. They may have recognized the formula of a CFC, or they may have realized that equation III represents a phase change.

Written-Response Questions

Performance on written-response questions has improved steadily since the beginning of field testing in January 1994, where a large portion of students did not even attempt to answer the written-response questions. Many students are now using specific examples from science and technology in their responses. Of the students who wrote this examination, one student received no mark for both written-response questions, 67.7% received 12 marks or more out of 24, and 16.2% received 20 marks or more out of 24. The average mark on the written-response questions was 58.0%.

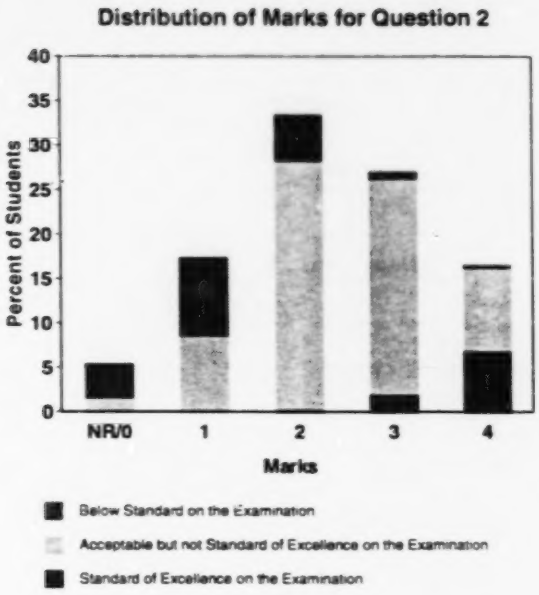




Question 1 This question required the students to state an hypothesis about an investigation, draw a graph from a data table, and interpret the data from the table. They were also required to write about the issue of ozone depletion. The question was attempted by all but two of the students who wrote the examination.

Most of the students were able to write a proper hypothesis and draw a graph from the data table. Although most of the students were able to make an interpretation from the data, some just restated observations represented in the table. Students demonstrated a good understanding of the issues related to ozone. Some students were confused about the relationship of ozone depletion to the greenhouse effect.

On this question, the average was 61.7%. On this question, 81.5% of the student population achieved the acceptable standard and 19.2% achieved the standard of excellence.



Question 2 This question proved challenging for many students. Thirty-four of the students who wrote this examination did not attempt this question.

Most of the students who attempted this question were able to contrast the position of "deep ecology" with the position of "unrestrained economic expansion." Almost all of these students were able to outline some of the steps that society must take to conserve the environment.

Students who achieved the standard of excellence provided specific examples of science and technology and their effects on the environment. They were able to describe instances where some scientific and technological developments produced both environmental and economic benefits.

On this question, the average was 52.5%. On this question, 62.1% of the student population achieved the acceptable standard and 16.5% achieved the standard of excellence.

For further information, contact John Drader (jdrader@edc.gov.ab.ca) or Corinne McCabe (cmccabe@edc.gov.ab.ca) at the Student Evaluation Branch at 427-0010.
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